3051/3 BGCSE

School Number	Candidate Number
Surname and Initials	

CHEMISTRY

PAPER 3 3051/3

Monday **1 June 2015** 12:00 noon–1:30 P.M.

Additional materials:
Graph paper

MINISTRY OF EDUCATION
NATIONAL EXAMINATIONS

BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

INSTRUCTIONS AND INFORMATION TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your school number, candidate number, surname and initials at the top of this page as well as at the top of all lined paper submitted.

Answer **ALL** the questions in **Section A** in the spaces provided on this question booklet and any **TWO** questions from **Section B** on the lined paper provided at the back of this question booklet.

Equations and diagrams should be given wherever they are helpful. Essential working must be shown.

The intended marks for each question or part question are given in brackets [ ].

Relative atomic masses are given in the Periodic Table printed on page 2.

ADDITIONAL INFORMATION

s.t.p. (t = 0 °C, p = 760 mmHg)

The volume of one mole of gas at room temperature and pressure (r.p.t.) is 24 000 cm^3.

For Examiner's Use	
Section A	
1	
2	
3	
4	
Section B	
5	
6	
7	
TOTAL	

This question paper consists of 11 printed pages, 4 lined pages and 1 blank page.

  [Turn over

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

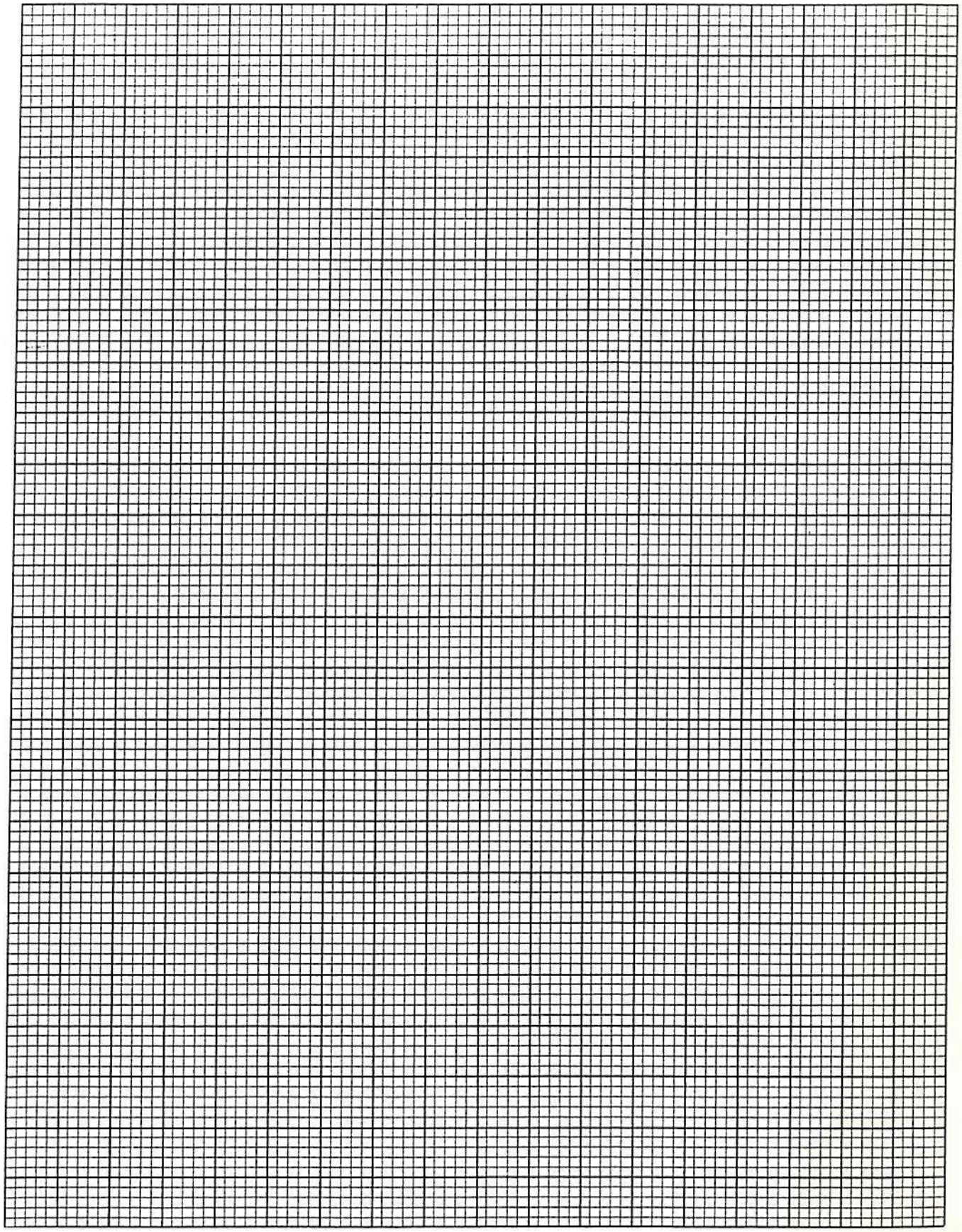
140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

EXAMINATION

School No.	Candidate No.	Level:	For Examiner's Use
Subject Number & Title:		Paper:	
Surname & Initials:		Section:	
Signature:	Date:	Qu. No.	



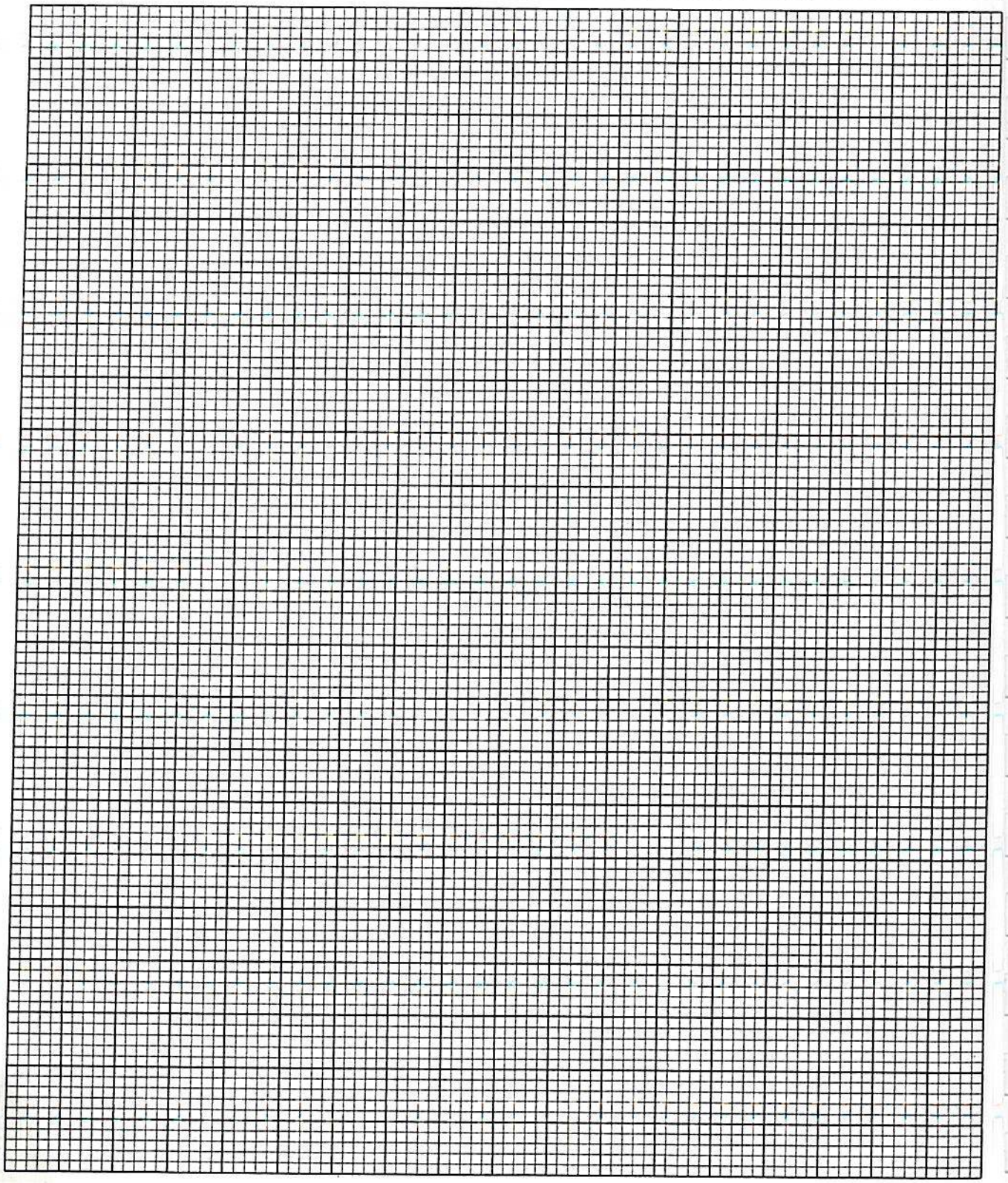
SCIENCE GRAPH PAPER

MINISTRY OF EDUCATION

BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

AB7

School No.	Candidate No.	Level:	For Examiner's Use
Subject Number & Title:		Paper:	
Surname & Initials:		Section:	
Signature:	Date:	Qu. No.	



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SECTION A

Answer ALL questions in this Section

1. (a) (i) Define the chemical term *isomer*.

_____

_____ [2]

(ii) Draw the two isomers of C_4H_{10} **and** name them.

name _____ name _____ [3]

(b) (i) Name the feature of a monomer which allows it to undergo addition polymerization.

_____ [1]

(ii) Write the general formula of a hydrocarbon monomer.

[1]

(iii) Write the addition polymerization reaction that changes CH_2CHCl into the addition polymer PVC.

[2]

(c) Name the ester formed from methanoic acid and ethanol.

_____ [1]

TOTAL MARKS [10]

2. Titanium exists within the Earth's crust as an ore called rutile (titanium dioxide).

Titanium is extracted from its ore in a series of steps called the Kroll Process.

Step 1 Rutile is liquefied (at 1 000°C)

Step 2 Chlorine gas is added to the liquefied rutile and titanium(IV) chloride forms.

Step 3 Titanium (IV) is reacted with sodium or magnesium metal in the presence of argon gas (at 850°C) and titanium metal forms.

(a) (i) Write a balanced chemical equation to show the extraction of titanium from titanium(IV) chloride using magnesium metal.

[2]

(ii) Name the type of reaction used to extract titanium from titanium(IV) chloride.

_____ [1]

(iii) State why argon gas is used.

_____ [1]

In the reactivity series of metals, titanium is located just below aluminium and above manganese. Titanium is also more reactive than carbon.

(b) Explain why the titanium is not extracted using electrolysis even though it is more reactive than carbon.

_____ [1]

Aluminium is the most abundant metal found in the Earth's crust. Aluminium is extracted from its ore (bauxite) using electrolysis.

(c) Write balanced half-reactions to show what happens

(i) at the anode;

[2]

(ii) at the cathode.

[2]

(iii) State why aluminium ore is dissolved in molten cryolite.

_____ [1]

TOTAL MARKS [10]

3. A student dissolved 6.00 g of impure potassium hydroxide (KOH) in pure water and the volume was made up to 1 000 cm^3. The student then measured out 25.0 cm^3 of this exact solution and added it to a conical flask. A few drops of phenolphthalein solution were added to the flask's alkali solution. The student carried out the acceptable method of titration and found that 28.3 cm^3 of 0.0400 mol dm^{-3} sulfuric acid was needed to neutralize the alkali.

(1 000 cm^3 = 1 L or 1 dm^3)

The equation for this reaction is shown below.

$$2KOH(aq) + H_2SO_4(aq) \longrightarrow K_2SO_4(aq) + H_2O(l)$$

(a) (i) Calculate the number of moles in 28.3 cm^3 of 0.0400 mol dm^{-3} sulfuric acid.

[2]

(ii) Calculate the concentration of the pure KOH in solution.

[2]

(iii) Calculate the **mass** of pure KOH in the solution.

[2]

(iv) Calculate the mass of the impurities in the impure KOH.

[1]

(v) Describe how a pure sample of solid K_2SO_4 is obtained from solution.

_____

_____

_____ [2]

(vi) State the colour change of the phenolphthalein that is seen at the end-point of titration.

from _____ to _____ [1]

TOTAL MARKS [10]

4. Ammonia is an important chemical that can be transformed into other chemicals. The formation of ammonia does not yield much product from the reactants. The reaction that makes ammonia is both reversible and exothermic.

(a) (i) Write a balanced equation for the formation of ammonia.

[3]

(ii) In the formation of ammonia, state whether the reactants or products have greater bond energy.

_____ [1]

(iii) Name a source of one of the reactants.

_____ [1]

(iv) State a use for ammonia.

_____ [1]

(v) Name one factor that could increase the yield of product **and** explain why this factor increases the yield.

_____

_____

_____ [2]

(vi) Calculate the volume of ammonia produced from 1.5 moles of hydrogen gas at r.t.p.

[2]

TOTAL MARKS [10]

SECTION B

Answer only **TWO** questions from this Section.

5. Fossil fuels are non-renewable resources. The fractional distillation of crude oil yields many fractions of hydrocarbons, ranging from lightweight volatile fractions to heavier less volatile fractions. Reactive simpler fractions are more commercially demanded than heavier fractions. Therefore, in order to meet the consumer demands, heavier fractions are reprocessed by cracking.

(a) (i) Write a balanced chemical equation to show the cracking of pentane. [2]

(ii) Name a catalyst used in a catalytic cracking process. [1]

Ethane and propane can also be obtained by cracking heavier fractions of crude oil. Propane is a saturated hydrocarbon used commercially in The Bahamas as cooking gas.

(b) (i) define the term *saturated hydrocarbon.* [1]

(ii) Draw the full structural formula of propane. [2]

(iii) Write a balanced equation for the complete combustion of propane. [2]

(iv) What volume of carbon dioxide gas will be produced at r.t.p. if 2 g of propane is burnt? [2]

In The Bahamas, plastic bags have replaced paper bags as the preferred material for grocery bags.

Ethene can be polymerized to polythene (polyethylene). Polythene (polyethylene) is a synthetic polymer that is widely used in packaging, plastic bags and plastic films.

(c) (i) Draw a portion of the polythene molecule to show **THREE** monomers. [2]

(ii) Name the type of polymerization reaction showed in (c) (i). [1]

(iii) State **ONE** reason why plastics should be recycled. [1]

A hydrocarbon was analysed and found to contain 82.8% by mass of carbon and had a molecular mass of 58.

(d) (i) Determine the empirical formula of the hydrocarbon. [4]

(ii) Determine the hydrocarbon's molecular formula. [2]

TOTAL MARKS [20]

6. The chemistry of fireworks is based on the theory of combustion. Fireworks contain oxidizing agents, such as potassium chlorate ($KClO_3$) or potassium nitrate (KNO_3), metals that produce coloured glows when heated and a fuel.

(a) Write the symbols of the metals that produce lilac and apple green flames in commercially produced fireworks. [2]

(b) Potassium chlorate is an oxidizing agent that supplies the oxygen needed for the mixture inside the firework to burn.

The equation for this reaction is shown below.

$$2KClO_3 \longrightarrow 2KCl + 3O_2$$

Calculate the mass of $KClO_3$ needed to make 48.0 kg of O_2. [3]

(c) The oxygen produced in the reaction reacts with sulfur and carbon to produce hot gases that expand rapidly causing the loud bang associated with fireworks.

The equation for this reaction is shown below.

$$S + O_2 \longrightarrow SO_2$$

(i) Name the substance which acts as the reducing agent in the reaction. [1]

(ii) State the oxidation number of S in SO_2. [1]

(d) Potassium nitrate is also an oxidizing agent.

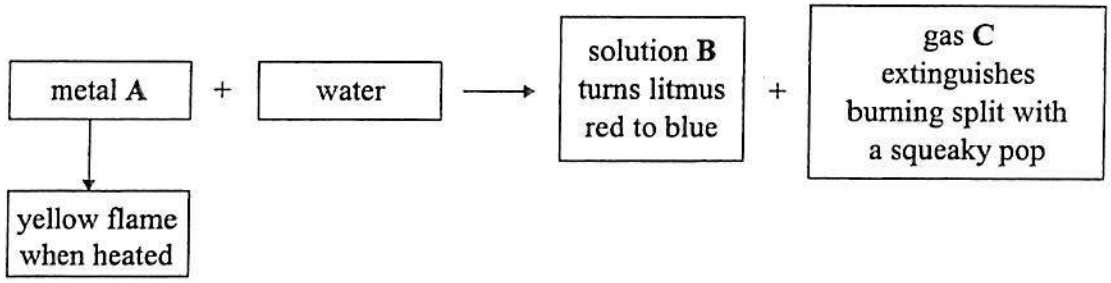
(i) Calculate the percentage of oxygen by mass in both $KClO_3$ and KNO_3. [3]

(ii) State whether $KClO_3$ or KNO_3 is the better oxidizing agent in the firework. [1]

(e) Metals are used to give fireworks their characteristic colours.

Identify the unknown metals used in fireworks and the other unknown substances labelled **A** to **I**.

Reaction 1



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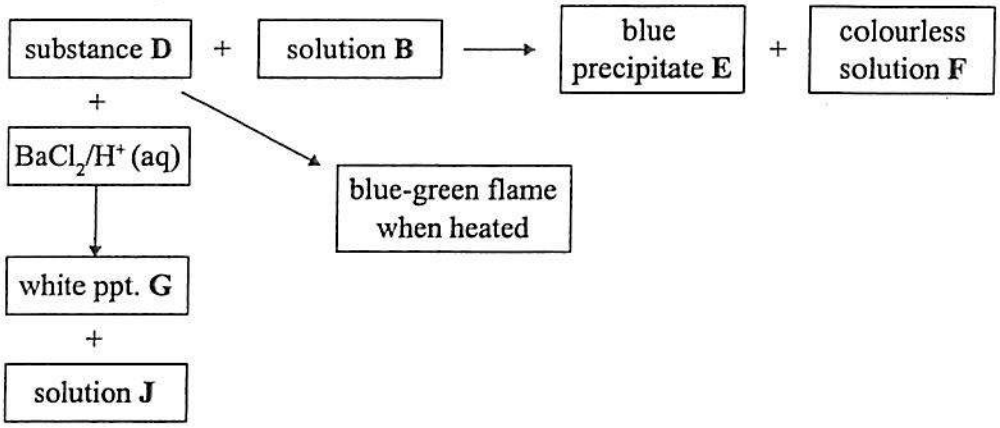
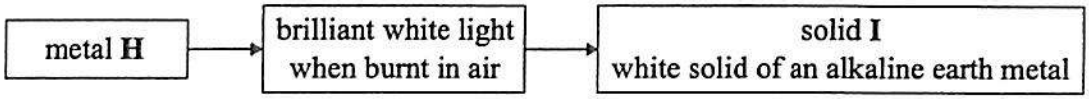


Reaction 3



[9]

TOTAL MARKS [20]

7. A student obtained data based on the rate of reaction between magnesium metal and excess dilute hydrochloric acid. The experiment was carried out at 20°C.

The table shows the data obtained in the experiment.

time/sec	0	20	40	60	80	100	120	140	160
volume of H_2 evolved / cm^3	0	19	33	45.5	55	62	67.5	70	70

(a) (i) Plot a graph of volume against time. Label the graph **A**. [6]

(ii) Find the volume of hydrogen evolved at 28 seconds. [1]

(iii) State at what time 11.5 cm^3 of hydrogen is produced. [1]

(b) Write a balanced equation for the reaction between magnesium and dilute hydrochloric acid. [2]

(c) At r.t.p., calculate

(i) the total number of moles of gas produced in the reaction; [2]

(ii) the mass of magnesium that produced the final gas volume. [2]

(d) Sketch carefully on the same axis, the graph obtained if only half of the mass of magnesium is changed. Label the graph **B**. [1]

(e) Explain, in terms of particles, what would happen to the rate of the reaction if a higher concentration of hydrochloric acid is used. [2]

(f) State what would happen to the initial rate of reaction **and** to the total volume of the gas given off, if the acid is heated to 40°C before the acid is added in the first investigation. [2]

(g) Give **ONE** disadvantage of using hydrogen instead of helium in balloons. [1]

TOTAL MARKS [20]

Question .....
Write on both sides of the paper

Question .....
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Question .....
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